SESSION 4B

IMPLEMENTATION OF GAAP FOR LIFE INSURANCE COMPANIES IN CANADA

(OPEN FORUM)

MR. MORRIS W. CHAMBERS: Good afternoon.

Welcome to our session on Implementation of GAAP for Life Insurance Companies in Canada. First, some history.

In March 1986, CIA Council formally adopted, by majority vote, the August 1984 Financial Reporting Committee majority report as the official CIA position with respect to financial reporting for life insurance companies under generally accepted accounting principles. In so doing, Council endorsed the policy premium method for determination of actuarial liabilities under GAAP. However, the method was recognized as being acceptable only if certain other conditions, as identified by the Committee on Financial Reporting, were met. These conditions are that:

1. Use of the policy premium method must be preceded by the establishment of appropriate standards for the provisions for adverse deviations from expected assumptions; and

2. The method can only be used in concert with surplus levels that have been determined according to appropriate standards.

There are those of us who believe that at least one other condition should be imposed upon use of the policy premium method. I'll say a little more about that later.

Having accepted the Financial Reporting Committee's recommendation, Council instructed the Financial Reporting Committee to develop standards for the provision for adverse deviation that would be required for the policy premium method to be acceptable for income reporting purposes. The task of developing standards for the retention of surplus was assigned to another committee. Members of that committee will discuss their work in one of the concurrent sessions.

A subcommittee of the Financial Reporting Committee had already been formed to study provisions for adverse deviation and so that group turned its attention particularly to deviations resulting from misestimation of the mean, that having been identified as the source appropriate for inclusion in liabilities for income statement purposes.

Over the ensuing 12 months, that subcommittee did a prodigious amount of trailblazing work. The fruit of its labor emerged in a report that was presented to Council at its meeting last June. Council

authorized the distribution of the report to Valuation Actuaries as a discussion paper. The subcommittee report proposes specific standards for the margins for each of the assumptions for interest, mortality, withdrawal, and expense, and includes a summary of the numerical testing of those standards.

The report does not define the expected assumption. It discusses only the margins for nonparticipating individual life branch business. Future extensions of the report will address margins for participating, group and health businesses. The standards are proposed as appropriate for any valuation method having a primary focus of income statement presentation. The standards are not limited to the policy premium method; in fact, I believe that the policy premium method is mentioned in the report only in the context of the test calculations.

The discussion paper has now been in the hands of Valuation Actuaries for about one month. In doing its work, the subcommittee has been exploring virgin territory. It does not presume that this is the absolute answer. Input from the members, and especially from Valuation Actuaries, is essential in order that we obtain the professional consensus required for enforceable standards. The subcommittee is preparing a survey to be distributed to recipients of the paper in order to gather and tabulate reaction to the proposals. One of the items on the agenda of this session is the discussion paper.

Few of you will be unaware of the controversy that has surrounded Council's endorsement of the policy premium method for GAAP reporting.

The two major concerns with the method are:

1. Its sensitivity to changes in assumptions, and
2. Its potential for front-ending future profits.

Most of the discussion that has taken place on these points has been on a theoretical level without the benefit of real examples. For instance, many supporters of the method have declared that while there is potential for front-ending of profit, in today's competitive environment of thin pricing margins, there is little likelihood that, with proper provision for adverse deviation, any profit would emerge at issue. However, few actual calculations have been provided in support of this contention.

Prominent among those who have registered these concerns about the method have been representatives of the federal Department of Insurance. Those who attended the Valuation Actuary's Symposium in Washington last October heard Donald A. McIsaac express those concerns. Since that time a number of meetings have been held between officers of the CIA and the department. The third of these meetings was held in mid-May and as a result of that meeting, the Financial Reporting Committee established a subcommittee under the

leadership of Michael Rosenfelder whose task it is to supplement the theory with practical examples of the application of the policy premium method. Practical application of the policy premium method is the other item on your program for this session.

I want to mention two other recent developments. On August 5, 1987 Robert M. Hammond, the Deputy Superintendent of Financial Institutions sent a letter to CIA President, J. Dickson Crawford, in which he formally stated the Department's position regarding the policy premium method. That letter states in part, "I and my actuarial colleagues involved in the regulation of life insurance companies remain opposed to the front-ending principle and do not think we should endorse it."

Most recently, on September 10, 1987 the Accounting Standards Committee of the Canadian Institute of Charter Accountants (CICA) met and recommended adoption of the revised Exposure Draft of Proposed Accounting Recommendations for Life Insurance Enterprises, to be mandatory effective January 1, 1989. Voting was concluded during the week of September 25, 1987 confirming the September 10 recommendations. That document prescribes the policy premium method for valuation of policy liabilities.

We have a problem. I'm not referring to the obvious problem of the CICA being on one side of the financial reporting fence and the Department of Insurance being at least partially on the other. One of

the arguments put forth by CIA proponents of the policy premium method for moving quickly to put it in place as the official position was that if we did not do so, some other group would impose a valuation method upon us.

The CIA did move quickly, at least relatively so. The result? We are faced with the spectre of another profession, the accounting fraternity, dictating an actuarial valuation method to actuaries. The embarrassing part is that we asked them to. Even if we all were to subscribe to the pontification that "It is right!," the fact remains that if in the future a better actuarial method for valuation were to be found we will be forced to ask the accountants for permission to use it.

Our first speaker is Kenneth A. Wright. In addition to his recent involvement in the business of the Rosenfelder subcommittee, Mr. Wright has been working with policy premium method for some time. He is here today to give us the benefit of his experience by providing some observations on the application of the method.

To lead you into that portion of the session, the next speaker, Mr. Larochelle, will provide an overview of the discussion paper on provisions for adverse deviations. He is a member of the hard-working subcommittee and was heavily involved in the test calculations that are included in it. (See Appendix A for discussion paper.)

MARGINS FOR ADVERSE DEVIATIONS

MR. MARCEL LAROCHELLE: I would like to begin by briefly describing the mandate entrusted to the subcommittee. The committee's task was to provide Valuation Actuaries with quantitative guidelines concerning the margins to use when valuing their reserves. These guidelines had to be specific, which meant they had to include practical examples. Realizing that 100% coverage of all situations was impossible, they had to be practical. Finally, the guidelines had to be stringent. We also had to define situations in which the potential for exceptions existed -- participating policies, for example, or non-guaranteed policies.

Valuation assumptions include mortality, expenses, interest, and lapse rate. Until now, we only focused on individual life insurance. The next step is group insurance.

As Mr. Chambers mentioned, margins have to cover for error in estimating the average and the deterioration over time. We are not concerned with statistical changes or disasters, which are covered by the minimum surplus.

The General Approach

First, the expected assumption must be defined. This assumption, however, is not part of our mandate; it should, in fact be defined by

the Valuation Actuary. Nevertheless, the committee drew up a list of points to help the Valuation Actuary determine the assumption. Furthermore, we have listed the desirable data sources to be used when determining the assumption. The maximum-margin assumption is defined by the subcommittee. (As I mentioned earlier, we decided on a practical rather than a technical approach to the situation.)

I would like to make a distinction between a margin and a provision. A margin is what is added to an assumption, whereas a provision is the effect of this added margin on the reserve.

Once the expected assumption and the maximum-margin assumption have been determined, they are weighted to define the valuation assumption. The weighting is done by the Valuation Actuary and should be somewhere between 20% and 80%. If the situation requires a low margin, we take 80% of the expected assumption and 20% of the maximum-margin assumption. If, on the other hand, we have a high margin, we take 80% of the maximum-margin assumption and 20% of the expected assumption.

The subcommittee tried to illustrate both low-margin and high-margin situations by providing a list of factors to be considered. At first, we tried to define the average situation and, based on the list of factors, the Valuation Actuary could decide whether he was above or below that average. We ran into a lot of trouble trying to define the average situation and ended up taking the opposite approach. We

defined the high- and low-margins situations, and defined what we considered to be three major considerations (see Appendix A).

If one of these considerations is present, the actuary should take at least 50% of the maximum-margin assumption. If there is more than one factor present, the actuary moves toward 80%; if none are present, he moves toward 20%. It is important to emphasize that the weighting may never be less than 20% of the maximum margin.

We will take a look at each of the four assumptions -- mortality, expenses, lapse rates and interest -- to see how the general approach applies to each of them.

Mortality

Turning first to mortality, the margin for adverse deviations depends on the expected assumption. The valuation assumption equals the expected assumption plus a margin which is defined as follows: If, after having consulted the list of factors to be considered, the Valuation Actuary judges that he is in a high-margin situation, then the constant to be added equals 15 divided by the expectation of life at attained age. However, if the actuary judges he is in a low-margin situation, the constant is 3.75 divided by the expectation of life.

The method used to define the margin was based on the method used for the CS041, CS058 and CS080 mortality tables, in which 35 rather

than 15 was used. This method produces smaller margins when the expected mortality table is conservative, and larger margins when mortality is low.

The Valuation Actuary must define his expected assumption. He should first make use of his company's experience to define his expected assumption, but, if his company's experience is not statistically valid, he should turn to intercompany studies.

The following is a summary list of some of the items to be considered in selecting the table.

- unisex table or separate tables for each sex
- combined table or separate tables for smokers and non-smokers
- will mortality projections be used?
- features of the product:
  - high cash value or none
  - with or without guarantees
- distribution system for the product:
  - agents, brokers of the company's marketing organization
- selection criteria
- reinsurance agreement
- average amount of insurance sold
- the company's policy on replacement of policies
- where will the product be sold?

Now it's time to assess the situation in which we find ourselves: a high- or low-margin situation?

For each assumption, three items of the description of the high-margin situation have been identified (see Appendix A). With respect to mortality specifically, one of the important items concerns the possibility of a poor estimation of the average: Are we dealing with a new type of benefit or a new way of distributing the product for which there is little experience? The other two significant items concern the deterioration of the average over time. 1) Is the persistency rate for these contracts low? If so, it is reasonable to expect that policies in force at a later date will be the poorer risks, which will have a negative effect on the average. 2) Is the new product sold under a mixed-risk category? Suppose a product is still sold today in a mixed-class -- for example, there is no differentiation between smokers and non-smokers. It is reasonable to expect that, other things being equal, the non-smokers will allow their policies to lapse at some point in order to re-qualify for a product which does distinguish between smokers and non-smokers. This will leave only smokers with the original product, which will cause the average to deteriorate. The same holds true if the product makes no difference between men and women. If at least one of the three significant items is present, the actuary should use at least 50% of the maximum-margin assumption.

Expenses

In regard to expenses, the maximum-margin assumption can be defined as the minimum percentage of total expenses which should be accounted for by administrative expenses, since administrative expenses have an impact on the size of reserves. We therefore tried to define a minimum percentage of total expenses which should go for administration. This minimum percentage is obtained from premiums, as follows.

RP1/ = (RPl + Z * FP)

where

RPl = RP X (1 + A/2)

FP = First year premiums

RP = Renewal premiums

A = (Number of paid-up policies)/(Number of renewals)

Z = (Average issue expenses)/(Average administration expenses)

The ultimate inflation rate must be greater than or equal to the ultimate interest rate less 3%.

The Valuation Actuary must also define the expected assumption for expenses. The committee determined that this hypothesis should be based on an internal company study and nothing else. This means that intercompany studies or another company's expense studies cannot be used to develop expense factors. Each company must conduct an internal study of its expenses. The subcommittee drew up a list of

administrative expenses to assist the Valuation Actuary in defining his expected assumption.

Finally, we will look at three significant considerations for the selection of a weighting between the expected and maximum-margin expense assumption (see Appendix A).

The first two concern a poor estimation of the average: 1) the distribution of expenses for the valuation does not reflect the amount of expenses shown in the financial statements; and 2) the agent, broker and general agent compensation contracts are not the same, and the distribution of insurance in force as well as of new business varies over time for these groups. The third significant consideration concerns the deterioration of the average over time: The use of a growth rate for insurance in force to reduce the ultimate inflation rate.

Interest

As with the expense assumption, the interest assumption used for valuation should be a weighted average of the expected assumption and the maximum-margin assumption. Like other assumptions, the minimum weight in a low-margin situation is 20% and the maximum weight is 80%. While studying this assumption, we began to question the idea that a reduced margin is always required. We decided that it was, at least in individual life insurance.

Only two recommendations of the Canadian Institute deal specifically with assumptions. Recommendation 3.11, dealing with interest, is the most complete. We used this Recommendation as our starting point.

First, let's look at the expected assumption. The sources of information used in determining the expected assumption are:

- Company studies and experience,
- Future investment rate (+ and - cash flows); and
- Asset default studies.

The underlying principle in Recommendation 3.11 was used. According to this method, cash flow and the rate of return are projected, taking into consideration factors which we will examine later. The Financial Reporting Committee is aware that making cash flow projections can be a complex exercise, and so a technical paper dealing exclusively with cash flow projection was being prepared. As a result, we had to develop our own method, just as each Valuation Actuary uses his own method for determining cash flows.

Factors to consider when determining the expected interest assumption include:

- investment income and asset allocation;
- risk of asset default;

- level of matching, including;

  possibility of disinvestment

  rates and terms of reinvestment

- options that may be exercised against the company, affecting both assets and liabilities. In assets, this would include redeemable shares, the level of policy loans and the cancellation of a commitment for a new investment. On the liability side, options would include redemption, a short-term guaranteed rate of a long-term guaranteed minimum rate.
- investment expenses.

Once the expected assumption is defined, the maximum-margin assumption is determined. It is important to remember that the procedure used here is the same as that used for the expected assumption.

The same basic data are used for assets and investment income generated by these assets. However, all Valuation Actuaries should use the same method for determining other data that is used to calculate cash flow projection.

I would like to make two important comments here. First, the high-margin assumption is not directly related to the expected assumption but in both cases, the same initial data is used. Second, in a well-matched situation where cash flows are predictable and few options may be exercised affecting assets, the high-margin assumption

and the expected assumption will be very similar. A weighted average will therefore be calculated from two quite similar interest assumptions. However, it is still always preferable to make both calculations.

Different data are used to project cash flows. For example, a "mismatch" is introduced into the assumption when the maximum-margin assumption is defined. It is commonly held that the most frequent situation in individual life insurance is one of reinvestment, so the first thing we do is define a low rate of reinvestment and a low duration of reinvestment of assets that will be the same for everyone. A 5-year period will be used for long-term products.

The second thing we do is define the options that go against the company -- for example, stock that can be redeemed. These options have to be exercised in full when the difference between the guaranteed rate on assets and the acquired in the future, the proportion of assets with options will increase by 25%.

The third thing we do involves the maximum-margin cash flow. The actuary must use cash flows that produce a conservative interest rate. This means the Valuation Actuary must define the expected assumption for lapses, mortality and expenses as well as a maximum-margin assumption for these three assumptions. He must perform tests with two sets of assumptions and select whichever of the two produces the lower rate.

I mentioned that the most common risk involves reinvestment. We also made a provision for the way in which the valuation assumption has to be defined in a disinvestment situation.

This completes the definition of the maximum-margin assumption for the interest factor.

As with the other assumptions -- mortality, expenses, and lapse rates -- three major factors were identified. A slight digression is required here: the criterion of maintaining an average margin when one of the three elements is present is fairly conservative.

Ideally, four major factors per assumption should have been defined, allowing us to say, for instance, that when two of the four are present, the actuary must be faced with at least an average-margin situation. We have developed a method for which changes in parameters are possible. People should not lose sight of this notion.

Now, back to the main discussion. We will look at the three major considerations for the interest assumption. The first concerns a poor estimation of the average: "the interest assumption is not directly determined from an explicit allocation of assets and investment return." The other two major considerations have to do with deterioration of the average over time. The first deals with matching: "Matching is inadequate or is inadequately tested." The second is: "Circumstances promote high asset turnover."

It frequently happens that the description of the low-margin situation is simply the negation of the description of the high-margin situation. Even so, we decided to include both descriptions in the report with additional details in certain cases.

Lapse Rates

We will begin with a brief review of how the lapse-rate margin should be calculated. The profit released for any year starting with the second year is equal to the product of three items: 1 minus the mortality rate, the margin for lapses and the non-forfeiture value less the reserve.

When the non-forfeiture value is less than the reserve, the margin for the lapse rate must be negative. Technical Paper #1[1] provides an ideal example, Term to 100, for which the lapse rate is very low. In the opposite case, when the non-forfeiture value is greater than the reserve, the margin for the lapse rate must be positive. In theory, at each duration, the non-forfeiture value should be compared to the reserve to determine whether the margin should be positive or negative. The exercise is complicated, but we have tried to simplify it.

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[1]Technical Paper #1, Valuation Technical Papers (Canadian Institute of Actuaries).

We began by considering the same approach as Technical Paper #1. We wished to define lapse rate that would apply to every company. The difference between our work and Technical Paper #1 is that, whereas the latter dealt with a single product, we wanted to cover the entire range of individual life insurance products.

After looking at the various types of product -- renewable term or reinsurance policies, for example -- we came to the conclusion that there was only one way to define the margin and that was as a percentage of projected experience as defined by the Valuation Actuary. This valuation assumption depends on the difference between the non-forfeiture value and the reserve. In the most frequent case -- namely, when the non-forfeiture value is less than the reserve -- the margin will be negative.

The valuation assumption in a high-margin situation will equal 60% of the expected assumption -- that is, the expected assumption is reduced by 40%. In the opposite case, rather than removing 40%, 40% is added. In a low-margin situation, rather than plus or minus 40%, there is plus or minus 10%. Theoretically, if the non-forfeiture value is equal to the reserve, there should be no margin. Even if there were a margin, given the formula we saw earlier, it would have no effect on the profit released.

How should the expected assumption for lapse rates be chosen? The data sources are as follows, in decreasing order of importance:

1) experience and company studies;

2) if 1) is not available:

   a) intercompany studies;

   b) the pricing assumption if a) is not available. The latter should be considered last-resort solutions.

If the actuary ever had to use sources such as the pricing assumption, he would be expected to be in a high-margin situation.

As with the other assumptions, there are three significant considerations, and the first has to do with a poor estimation: The company has little information on its experience. The following two considerations concern a situation in which the non-forfeiture value is less than the reserve such as is the case when a high margin is called for when low lapse rates are likely, such as Term to 100. The first of these two considerations is that the compensation policy promotes persistency. The second is that termination of the contract is disadvantageous to the insured.

It may be difficult, at first glance, to see why these elements call for a high margin. Here again, I refer to Technical Paper #1 according to which the maximum-margin assumption is at a 3% lapse rate. Under certain conditions calling for a higher margin, the way in which it was obtained was to reduce the lapse rate to 2%.

This completes the description of our method for each of the four assumptions.

Let's now get down to practical matters. The numerical examples are very important, for two reasons. First, an actuary always wants to know if the system being developed is practical. Second, when we defined the maximum-margin assumptions, we gave you a series of factors and said, "Don't try to reason them out just yet." This can be done by using numerical examples (see Appendix A).

PRACTICAL IMPLEMENTATION OF GAAP IN CANADA

MR. KENNETH A. WRIGHT: There has been a great deal of interest and discussion in Canadian actuarial circles in the past few years concerning the policy premium valuation method. Many people, and I am one of them, would like to see this method replace the 1978 Canadian Method as the statutory valuation basis in Canada. My remarks will focus on the benefits of the method as compared to the 1978 Canadian Method, and the reasons we have adopted the policy premium valuation method at Confederation Life for our quarterly internal management reporting. I have a few observations to offer on the differences in reserve levels produced by the two approaches.

Over the past 10 years or so, at Confederation Life we have developed a number of valuation programs to calculate the reserves that we require for a variety of reporting purposes such as the Canadian Annual Statement, the Canadian Tax Return, the Department of Trade and Industry Return and the NAIC return. All these programs calculate reserves on policy data extracted from our three individual

administration systems. All reserves are calculated on the seriatim basis, and the 1978 Canadian Method reserves are calculated by using double decrement functions with explicit provisions for future dividends.

Over the past two years, we have gradually developed the capability of producing reserves on the policy premium basis. Initially these reserves were needed as part of the valuation process for the disposition of some of our Caribbean business. However, we quickly became appreciative of the virtues of the policy premium valuation method, and quickly adopted it as the basis for our management reporting and for statutory reporting for certain peculiar blocks of business for which we felt the 1978 Canadian basis did not apply such as the unit linked business written mainly by our subsidiary in the U.K., and Universal Life business written in the U.S. I will elaborate further on the reasons we were enamoured with the policy premium method, but first I would like to quote, rather extensively, from a letter dated February 4, 1987 from Kenneth T. Clark, in his capacity as president of the CIA, addressed to the Federal Superintendent of Insurance. The purpose of the letter was to persuade the federal authorities of the benefits of replacing the 1978 Canadian Method with the policy premium method as the mandated basis for statutory reserves in Canada. Mr. Clark's description of the benefits were as follows: "The method can be explained to lay persons. Its adoption will reduce the unfortunate mystique which has traditionally

surrounded actuarial calculations and which has undermined public confidence in the appropriateness of the actuary's work."

The method eliminates difficult tests and artificial distinctions, thus permitting the actuary to concentrate on appropriate assumptions: The method is prospective, its application depends entirely on what is expected to happen in the future and does not depend at all on what has happened in the past. There is no need for an "assumption" about what has already occurred between the issue date and the valuation date.

There is no reliance alas, often made now and often ill-founded on the conservatism created by the excess of the policy premium over the valuation premium.

There is no danger that a policy-by-policy test for premium deficiency will be omitted or be incorrectly made; the test is not necessary. There is no danger that a policy-by-policy test for recoverability of acquisition expense will be omitted or be incorrectly made; the test is not necessary. There is no danger that a policy-by-policy test to verify that an explicit expense assumption does increase the actuarial liability will be omitted or be incorrectly made; the test is not necessary.

There is no danger of incorrect classification of expenses among

acquisition, administrative, and general overhead. Expenses are either those which have already been paid or those which are going to be paid. The valuation ignores those which have already been paid; the valuation is prospective. The valuation makes provision for 100% of those which are going to be paid. An assumed expense in the valuation always increases the actuarial liabilities.

The actuary must make an explicit expense assumption; he need no longer hope that, or tediously test whether, the excess of the policy premium over a benefit valuation premium makes adequate provision for future expenses.

The margin for adverse deviations is what the actuary explicitly assumes, no more and no less. There is no hidden margin and, hence no hidden, frequently illusory, comfort.

The incentive to review assumptions often is maximized.

In a net premium valuation method, the assumptions must be laid out by policy year. This is an unnatural way to lay out the interest rate assumption. The natural way to lay out that assumption is by calendar year. To do so is straightforward in the policy premium valuation method. To do so directly is impossible in a net premium valuation method.

The policy premium valuation method reduces the amount of modelling needed to do a valuation.

The traditional net premium valuation method works with traditional products but one encounters these less and less. It is difficult, and in some cases impossible, to calculate a valuation premium for modern products.

With a net premium valuation method, intercompany comparisons of valuation assumptions are difficult, because of the complex, sometimes unnatural, relationship between an assumption and the actuarial liability. A 10% increase in mortality rate assumption can markedly affect the actuarial liabilities in one company, and have little effect in another. An actuary must sometimes laboriously test to see whether the margin for adverse deviations is additive or subtractive. With the policy premium valuation method, the relationship between an assumption and the actuarial liability is usually simple and predictable.

There is a general agreement that better business planning (forecasting) and better asset-liability management are needed. The policy premium valuation method is conducive to these because it permits the component parts of the liability (future death benefits, future cash value benefits, future expenses, future premiums) to be determined separately and year-by-year rather than being squashed into a single valuation factor. The business planning by-products of a valuation by the policy premium valuation method are wanted by

general management, so the actuary's call for systems support is more likely to be heeded.

There is general agreement that actuaries must make greater use of dynamic assumptions. We think this is practical only with the policy premium valuation method.

The simplicity and clarity of the policy premium valuation method run the gamut. It is easier to write standards of practice for it, easier for the actuary to apply them; easier for a regulator and a peer reviewer to understand what the actuary has done."

At the risk of repeating the points made by Mr. Clark, we were specifically motivated by the following reasons.

1. The policy premium valuation method produces more realistic reserves. This is largely due to the removal of the artificial 150% limitation on expenses.

2. It is a great deal simpler to apply. For a number of new type products, particularly the asset linked business issued in the U.K., it is very difficult to apply the Canadian method. It is easier for us to extend our calculations to a number of very old and obscure type products for which approximate reserves had been calculated since it is not necessary to know the past history of premium scales or cash surrender value (CSV) formula or to program for various options that may have existed in the past.

3. It is a more powerful analytical tool. By using realistic assumptions without the valuation margins, added insight can be gained into the total margin available for adverse deviations, and management operating results can be better analyzed. Analyzing new business issued during the calendar year on realistic assumptions permits a comparison with the acquisition expenses incurred and the determination of the realistic gain or loss on the sale of new business.

Before we moved, for management purposes, completely to the policy premium method, we initially thought we could get improved results by simply removing the 150% limitation on acquisition expenses. However, a few areas of weakness in the actual mechanics of our calculation of the 1978 Canadian reserves became evident. The first area concerned our treatment of acquisition expenses that were assumed to be a constant percentage of first-year premiums as paid. While this was fine for annual business, it resulted in the deferral of much acquisition expense on monthly business until the premium was actually paid. The other problems were related to the fact that the statutory provision for future administration and indirect expenses takes the form of a comparison between the valuation net premium and the gross premium. Our valuation programs were written such that it was difficult for us to allow for an inflating per policy expense assumption, and had the added drawback that no expense provision was made for policies after premiums ceased. In fact, it seems to me that the law is silent on the valuation of paid-up policies and invites their valuation on a net premium basis without explicit allowance for future expenses.

As a result we decided that while fully retaining the logic to calculate 1978 Canadian method reserves, we would introduce parallel logic into the programs to simultaneously calculate policy premium method reserves. This was actually a relatively straightforward change for us to make since nearly all the data needed to calculate the new reserves was already being calculated for the old. Most of the effort involved editing changes since rather extensive edits are produced by our valuation programs and we now had additional reserves to show on these edits.

After completing these changes, we were in a position to draw conclusions as to the relative reserve levels on three bases; the 1978 Canadian Method, the 1978 Canadian Method without the 150% limitation, and the policy premium method. The results were as follows.

1. On nine blocks of policies representing approximately 90% of our total Canadian premium paying policies, the policy premium reserve was about 87% of the 1978 Canadian reserve.

2. Almost all the difference between the two reserves was entirely attributable to the removal of the 150% limitation. In other words, there was no evidence in any of the nine different blocks of the front-ending of profits.

3. Nearly all the difference due to the removal of the 150% limitation arose on policies issued in 1980 and later.

4. More than two-thirds of the reduction in the reserve level was offset by an increase in the surplus appropriation for CSV deficiency and negative reserves.

One of the fears, often expressed, is that a consequence of the adoption of the policy premium valuation method is it results in the front-ending of profits. While arguments have been developed that to the extent that this occurs it is right and proper to recognize these profits, and I happen to agree with this position, I have serious doubts that the phenomenon is of much significance at all.

The front-ending of profits could occur on the sale of new business, at the time that a switch in reserve methodology such as a change to the policy premium method is made with respect to old business, or the result of a weakening of actuarial assumptions at some point in the future.

I believe that the people who are concerned about the front-ending of profits are most concerned with the first situation, the sale of new business. Yet I am convinced that this is where front-ending of profits is least likely to happen. I find it very difficult to believe that in today's highly competitive marketplace which puts great pressure on the pricing actuary he can develop a product that when valued by the Valuation Actuary will result in the front-ending of profit. This would be the equivalent of saying that for each valuation assumption the margin for profit in the pricing was greater than the

margin a prudent Valuation Actuary would require for future adverse deviations. It would be the equivalent of saying that the Valuation Actuary was using a higher interest rate, a lower mortality assumption, a lower expense assumption and a more liberal policy termination assumption than the pricing actuary. I don't think this is the reality of the marketplace today. Having worked 20 years ago in the product development area of Confederation Life and remembering how difficult it was then to justify competitively priced products, I don't think the situation has changed all that much in the intervening years. As for the future, I doubt that even the most optimistic believe that the future is going to be rosier than the present.

With respect to old business, particularly participating business, I do not believe that a switch to the policy premium reserve method will result in the front-ending of profits either. This conclusion however, is somewhat predicated on the way future indirect costs are applied in the valuation process. While it is probably common for the pricing actuary to allocate expenses in a variety of ways -- such as per policy, as a percentage of premium and per 1000 of face amount -- there is no need for the Valuation Actuary to follow suit. Future costs that are not clearly a function of premium such as premium tax, commissions and commission related expenses (agent's bonus, fringe and welfare costs) should all be allocated on a per policy basis and must assume a rate of future inflation. Current policy fees and intercompany expense studies indicate that $50 per policy is in the ballpark for this type of expense. I would be surprised when upon

looking at the policies that were issued more than 15 or 20 years ago if the average size premium for these policies was much more than $100. When you value these policies with this type of expense assumption with an appropriate allowance for inflation, I don't think you will find many instances of front-ending of profits.

Finally, I believe that valuation assumptions should be closely monitored on an annual basis. This will eliminate the situation where the correction of a long out-of-date assumption does result in a significant reserve change.

I would like to offer a few practical thoughts for anyone who may be considering developing procedures to produce policy premium reserves.

The first concerns the treatment of expenses. As Mr. Clark said, expenses are those which have been paid or those which are going to be paid. Under the 1978 Canadian Method much emphasis is on the former, whereas under the policy premium method only the latter have any impact on the reserves. Because of the 150% limitation, the separation of expenses into the various categories of acquisition, administrative and general overhead, may in the past have been somewhat more casual than was justified. A company should examine its entire current expenses and allocate them to one of these three categories. While the acquisition expense category is not needed by the policy premium method it should be noted that this category includes all the expenses up to the instant of issue of the policy.

This means that unlike the definition of acquisition expenses for the 1978 Canadian Method, it does not include first-year commission or commission related expenses.

My second comment concerns the practical mechanics of the policy premium valuation. While one of the main virtues of the method is its simplicity, an added virtue in my opinion, but arguably not in the opinion of all, is that this method virtually dictates that a seriatim basis with an explicit withdrawal and explicit dividend assumptions be made.

Before I close, I would like to take one last look at the 1978 Canadian Method. It is often described at a net premium method. In fact, it is nothing of the sort. The Commissioners Valuation Method, the New Jersey Valuation Method are net premium valuation methods. No method that entails, as the CIA Handbook says it does, a valuation premium to amortize acquisition expenses and a valuation premium for future administration expenses can properly be described as a net valuation method, unless I have totally misunderstood the definition of the term "net." If it is not a net premium method, then what is it?

As far as the valuation of new business is concerned, the net valuation method is in essence, a policy premium valuation method with a very conservative and totally arbitrary limitation on the initial reserve that otherwise would have been established. Under normal circumstances the policy premium method will give a negative reserve

at issue equal to the margins put in the pricing of the product to pay acquisition expenses. The Canadian Method effectively puts an artificial ceiling on this initial negative reserve.

For the valuation of policies after issue, an accurate description of the method is less clear. I have always had a great deal of uncertainty as to what the basis of the appropriate assumptions for the valuation of older business should be under the 1978 Canadian Method. Since it is required to calculate a net premium as of issue for these policies, questions arise as to the appropriate assumption for interest, mortality, policy termination rate, acquisition expense rate, administration expense rate and dividend rate for these policies. Should assumptions be based on the status at issue, the experience over the intervening years, the expectation for the future or a combination of these. I have never been able to get a satisfactory answer to these questions. I think conventional and authoritative opinion dictates that I should use a mixture of assumptions; at least historical for acquisition expense, and probably current for all other assumptions.

I find myself totally mystified by nature of the premium that I calculate by these methods. What sort of a premium is it that I am calculating that assumes the current policy termination rates and interest rates have always been in effect, but the acquisition expense is the historical one, not to mention the various dividend scales that have been in place over the years since issue? Not only would I have

difficulty explaining just what it was that I was calculating to lay people, I would have difficulty explaining it to other actuaries and even to myself!

I am disturbed that a conscientious actuary, forced to calculate reserves by these arcane rules, must make adequate, but not excessive, provision for adverse deviations, and will compensate by making assumptions with margins greatly reduced to eliminate the redundancy. It is impossible to establish valuation assumptions with explicit but controlled margins for adverse deviations without using the policy premium valuation method. Any other method that includes significant, but undefined margins, will either result in gross redundancies, or the shaving or elimination of desirable margins to compensate.

APPENDIX A

The following is a discussion paper published by the CIA Subcommittee on Provisions for Adverse Deviations which was used as background reading for Session 4B. Some references are made to this paper in Session 4B.

Discussion Paper from the CIA Subcommittee on Provision for Adverse Deviations

TABLE OF CONTENTS

SECTION 0

INTRODUCTION

0.0 ENVIRONMENT

This document is a discussion paper on the standards for the Provisions for Adverse Deviation. It represents the position of the Financial Reporting Committee on the matter and is sent to the Valuation Actuaries in order to gain input on the different parameters.

According to the Committee's current mandate, these standards had to be developed for use with the Policy Premium Method and only for the income statement under GAAP. Nevertheless, the Committee considers that these standards, in theory, can be applied to any method whose primary focus is an appropriate income statement.

These margins are not to be used for solvency purposes or for reporting in the current (Pre-GAAP) environment. In the development of this paper, the Committee has not considered the work of the Solvency Standards Committee. However, both the Financial Reporting Committee and the Solvency Standards Committee were each waiting for the first draft from the other's committee to consider the different approaches that were taken.

For each assumption, there must be a margin only for the misestimation of its mean and the possible deterioration of the mean. Statistical fluctuations and catastrophic occurrences should not be taken into consideration since this will be dealt with by the Solvency Standards Committee.

Under a GAAP environment, some adjustments of the valuation technique papers might be deemed necessary. For this reason, this paper does not necessarily conform to the valuation technique papers distributed up to now, which dealt with very precise questions.

This report is only concerned at this time with nonpar individual life policies. the Committee is still working on par, group and health business using the same general approach.

0.1 OVERVIEW OF THE APPROACH

In essence, the Committee's approach was to transform the general qualitative standards of recommendation 3.09 into a series of both qualitative and quantitative specific standards that would help the Valuation Actuary in determining the level of the margin.

More precisely, the approach is an attempt to determine a "fair risk charge" with an "appropriate release in the income statement" for the risk assumed in every period regarding each assumption. In this area, the Committee has been breaking new ground. Moreover, we feel that at this stage there is no "right answer" to the question of how much margin is necessary in each circumstance.

These standards have been defined for each of the interest, mortality, lapse and expense margins. For the mortality and lapse assumptions, the valuation assumption is a percentage of the expected assumption. For the interest and expense assumptions, it is also necessary to define a maximum margin assumption. For these, the valuation assumption is a weighted average of the expected assumption and the maximum margin assumption.

The expected assumption should be the Valuation Actuary's best estimate on the future experience of the product in his company. In the attached report, we are including a list of items to be considered by the actuary for the expected assumption. Although these items are highly recommended by the Financial Reporting Committee, they are not as yet mandated.

The margins have to be determined by the Valuation Actuary according to the situation of his own company, with regard to the considerations mentioned in the descriptions of the low and high margin situations.

Finally, it is very important to remember that the parameters presented in this paper for each assumption should not be evaluated in isolation. They should be considered with regard to the provisions they produce for each product in relation to parameters of other assumptions. Numerical examples are included in the report primarily for that purpose (refer to Section 6).

SECTION 1

DEFINITIONS

Margin — Part of the valuation assumption covering the uncertainty related to the expected assumption (see recommendation 3.06).

Provision — Additional reserve created by adding a margin in an assumption.

Adverse Deviations — In this document, adverse deviations refer to the misestimation and the deterioration of the mean of the assumption and ignores statistical fluctuations and catastrophic occurrences.

Parameter — Value from which a valuation assumption is directly or indirectly defined.

i. Type of parameters that directly define the valuation assumption:

Mortality

This parameter is a constant, divided by the life expectancy of the expected mortality assumption. The parameter defines the margin.

Lapse

This parameter is a percentage modifying the expected assumption in order to arrive at the valuation assumption.

ii. Type of parameters that indirectly define the valuation assumption:

In these cases, a 2-step process is involved:

1st Parameters are chosen to define a maximum margin assumption.

2nd The valuation assumption is then defined as a weighted average of the expected assumption and the maximum margin assumption.

Interest

Parameters relate to all the elements of cash flow, assets and investment return projections. These parameters, together with data on current assets backing the product, are used to define a maximum margin assumption.

Issue and Administrative Expenses

The parameter, currently named Z, will be the average issue expenses divided by the average administration expenses. This parameter, together with the distribution of premiums between 1st year and renewal, will verify to what extent a minimum percentage of general expenses are assumed as administrative expenses.

The expected assumption modified (if necessary) to meet the minimum percentage will become the maximum margin assumption.

High/Low Margin Situations

For each assumption, extreme cases in terms of level of the margin are described by qualitative standards (herein called considerations).

The situation of the product and the company with regard to considerations mentioned in these 2 descriptions will be the basis for the Valuation Actuary to determine the level of the margin.

Important Considerations

If present, an important consideration adds some restrictions to the minimum margin.

SUBCOMMITTEE ON PROVISIONS FOR ADVERSE DEVIATIONS

VALUATION ASSUMPTION FOR APPROPRIATE INCOME STATEMENT

SECTION 2

Line of business : Individual Life

Assumption : Mortality

2.0 INTRODUCTION

The subcommittee worked on three (3) main approaches:

A) A valuation table equal to a blend of the expected assumption and a standard table. Both the FRC and our subcommittee agree that this method may produce some unusual results. We must respect as much as possible the distribution of mortality experienced and expected in each company as characteristics of each insured population may vary.

B) A valuation table equal to x times the expected assumption. This kind of formula can't be applied straightforward. We must use some adjustment for lower and higher groups of ages. By the same token, fairness can't be achieved if some other factor isn't present to take into account the different level of mortality of the table.

C) A process similar to the one used for the mortality tables 41CSØ and 80CSØ and consistent with the one used with the 58CSØ. This method solves the preceding problems and is in line with our basic principles.

The first two were rejected because of problems it generated as described before. The proposed method is already generally accepted by the profession, does not cause any particular problem and meets the basic requirements. The level of margins proposed is consistent with other assumptions and lower than CSØ margins. Here we are looking for proper income reporting rather than solvency as with CSØ.

Also, this approach implies that the margin is inversely related to the expected assumption, a desirable characteristic. (Please refer to TSA XXXIII p. 640-655 for more details).

2.1 DEFINITION

The valuation assumption is the sum of an expected assumption plus a margin defined as a constant divided by the expectation of life.

The margin will be determined by the Valuation Actuary considering the situation of the product and his company. It should lie between the following:

	Margin per 1000
Situation of high margin	$\frac{15}{e_x}$
Situation of low margin	$\frac{3.75}{e_x}$

Where e_x is calculated on the curtate basis using ultimate rates and "x" is the attained age.

When 1 out of the 3 significant considerations leading to a high margin situation are present, the margin must be at least the average of the high and low margins.

2.2 EXPECTED ASSUMPTION

The expected assumption should be the Valuation Actuary's best estimate as to the future experience and trend for the product.

When available, he should consider successively the following sources:

1. His own company's experience and studies. (Only to the extent that it is more credible than 2. below).

2. Intercompany studies if 1. is not available.

In defining the expected assumption, the actuary should consider the following list of items:

- Number of distinct rates
  - o Composite vs smoker/non-smoker
  - o Unisex vs male/female

- Mortality projection (possible variation by age)

- Plan type
  - o Short term vs whole life

- Characteristics of the product (options and benefits)
  - o Conversion privilege
  - o Paid-up options
  - o Guaranteed insurability
  - o Anti-selection option

- Distribution system
  - o Direct mail
  - o Brokers
  - o Career agents

- Underwriting rules

- Reinsurance an/or coinsurance treaties (level of the retention)

- Average face amount

- Policy of internal replacement

- Pricing plan: desired markets

- Geographical situation (location of the company)

- External factors: social, economical and medical developments

2.3 DESCRIPTION OF THE HIGH MARGIN SITUATION

Important Note

The actuary must consider that the situation is one of high margin when some of the following considerations (or similar ones) are known at the time of the calculation of reserves.

Until reliable industry experience is obtained, this condition will likely to be in effect for the mortality of most products.

I. Misestimation

* o it is a new type of benefit or a new way to distribute the products with limited experience resulting in published or experience data being either inapplicable or not credible (e.g.: new desired market, mortality study without detailed results);

o there is little similarity in the characteristics of the insured (e.g.: same premium by sex and/or smoking habit);

o low volume of business.

II. Deterioration

A) COMPANY

i) Structural

Products

* o the persistency rate of the product is low (e.g.: 5 year renewable term; old product with low return on cash values; etc...)

Distribution system

o antiselection by the sales force.

Management

o the company is slow to adjust to changes affecting the mortality experience of its products.

ii) Discretionary

Products

* o new product with composite rates (for both sexes, different smoking habits, different classes of risks, etc...);

o a policy of internal replacement is favorable to rotation of the old business;

o accrued antiselection on certain options and benefits (paid-up addition, guaranteed insurability option), some option like conversion privilege affects the mortality of certain specific plans of a company.

Management

o weaker underwriting criteria are implemented.

* : significant consideration.

2.4 DESCRIPTION OF THE LOW MARGIN SITUATION

Important note

The actuary must consider that the situation is one of low margin when many of the following considerations (or similar ones) are known at the time of the calculation of reserves.

I. Misestimation

- o product for which the company has credible experience data;
- o characteristics of the insured lives are very similar.

II. Deterioration

A) COMPANY

i) Structural

Products

- o the product, well adapted to evolving market conditions, has a good persistency rate.

Distribution system

- o there is a non-negligible selection process by sales personnel.

ii) Discretionary

Products

- o a policy of internal replacement is unfavorable to rotation of the old business.

Management

- o stronger underwriting criteria are implemented.

B) ENVIRONMENT

Favorable medical developments.

SUBCOMMITTEE ON PROVISIONS FOR ADVERSE DEVIATIONS

VALUATION ASSUMPTION FOR APPROPRIATE INCOME STATEMENT

SECTION 3

Lines of business : All

Assumption : Interest rate

3.0 INTRODUCTION

In determining the interest rate assumption, the actuary should consider the cash flow associated with the different products. In doing so, he should consider the following variables:

- valuation of assets and allocation of investment income; asset default risk;
- matching (including possibility of disinvestment and rates and terms of new money investments and reinvestments);
- possible options against the company;
- investment tax rates;
- investment expenses.

For the expected assumption, the determination of these parameters is based on the Valuation Actuary's best estimates. He has to consider realistic cash flows.

For the assumption with maximum margin, the Valuation Actuary should follow the elements defined in Section 3.3. In projecting the cash flows, he should analyze different situations and choose the one that will result in the most conservative interest rates.

3.1 DEFINITION

The valuation assumption is a weighted average of expected assumption (Section 3.2) and a maximum margin assumption (Section 3.3).

	WEIGHTING	
	Expected Assumption	Maximum Margin Assumption
Situation of high margin	20%	80%
Situation of low margin	80%	20%

The weighting will be determined by the Valuation Actuary considering the company's situation and the product.

When 1 out of the 3 significant considerations leading to a high margin situation are present, the weighting must include at least 50% of the maximum margin assumption.

3.2 EXPECTED ASSUMPTION

The expected assumption should be the Valuation Actuary's best estimate of the future experience of the product.

When they are available, he should consider the following sources:

1. his own company's experience and studies;

2. future investment rates (positive and negative cash flows);

3. asset default studies;

In defining the expected assumption, the actuary should consider the following variables:

Valuation and allocation of assets and investment income:

- Segmentation of assets
- Method of allocating investment income
- Types of assets backing the liabilities
- Method for valuing assets
- Capital gains and losses

Asset default risk:

- Concentration vs diversification (geographical, industry...)
- Types of investments (bonds, mortgages, shares...)
- Kinds of risks (interest/dividends, capital value)
- Liquidity
- Quality of asset
- Term of investments
- Economic conditions

Matching:

- Need for reinvestment or disinvestment
- Current and future investment rates
- New money or aggregate product
- Possible options against the company
- Flexible term of investments (extendible or callable)

Possible options against the company:

- Asset
    - o cash value and reinvestment
    - o early repayment and breaking the contract
    - o non-guaranteed income
    - o forward commitments and breaking of commitments
    - o policy loan borrowing and repayment
- Liability
    - o cash value and policy replacements (interest rate credited, cash values, penalties)
    - o options to alter or adjust the policies
    - o minimum rate guaranteed over a long period
    - o rate guarantee

Funds:

- PAR vs NON PAR contracts
- Possibility of rapidly adjusting the dividend scale

Fiscal considerations

Investment expenses:

- Level of expenses
- Correlation between investment expenses and the inflation part of the investment rate.

3.3 MAXIMUM MARGIN ASSUMPTION

Note

The valuation technique paper on new money products will define parameters which we will use for the determination of the margin

for the interest rate. For the moment, we will define the parameters or use those defined in the recommendations and explanatory notes of the C.I.A. to illustrate our approach.

The following parameters should be considered in the determination of the rate with maximum margin:

Reinvestment rate:

- for investments to be made 20 or more years in the future, the reinvestment rate is the average of:

  1. 4%
  2. 50% of the average yield of the last 3 years on long term Government of Canada bonds;

While for investments within the next 20 years, the rate could be derived by interpolating between the current rate and that applicable after 20 years.

If the main risk is a risk of disinvestment, the actuary should consider a future reinvestment rate greater than the current one to avoid capital gains.

Term of investments:

Term of products	Maximum term of investments to be acquired
10 years or longer	5 years
less than 10 years	3 years

If there is a risk of disinvestment, the valuation rate should be tested assuming that the investments acquired in the future won't have a term shorter than the ones recently acquired.

Options against the company

- Assets

  For the assets with repayment options presently owned, options will be fully exercised when the difference between the guaranteed rate on the asset and the current rate is equal to or greater than 5%. (Interpolate when the difference is smaller than 5%).

  For all the assets acquired in the future, the proportion of those assets that will have repayment options will be equal to 125% of the proportion of the assets with a comparable term owned by the company in the recent past.

- Liabilities

  To define cash flows, consider the more conservative of the expected assumption and the maximum margin assumption for the lapse, expense and mortality assumptions.

Risk of default:

For the assets presently owned, the margin for the risk of default will be treated as a reduction in the rate of return. The magnitude of this reduction will depend upon the quality of the asset.

Fiscal considerations and investment expenses:

(STILL TO COME)

3.4 DESCRIPTION OF THE HIGH MARGIN SITUATION

Important note

The Valuation Actuary must use the 20-80 weighting (20% for the expected assumption and 80% for the maximum margin assumption) when some of the following conditions (or similar ones) are known at the time of the calculation of reserves.

I. Misestimation

- o the valuation applies to a new product or a new type of benefit with little experience for cash flows projections;
- o investment allocation method not particularly sophisticated (e.g., average funds);
- * o the interest rate assumption is not directly determined from an explicit allocation of assets and investment return;
- o the valuation interest rate is mainly affected by future interest rates.

II. Deterioration

A) COMPANY

i) Structural

Products

- o antiselection is possible due to loose contractual clauses;

- o cash values (other than non-guaranteed cash values with market value adjustment) are important.

Assets

- o liabilities are covered by assets where options could possibly be exercised against the company:
  - callable assets
  - extendible assets
- o matching is inadequate or inadequately verified;
- o quality of assets is lower than average.

Management

- o the company slowly adjusts to changes affecting its performance;
- o the investment policy is not clearly defined or understood by the actuary.

ii) Discretionary

Circumstances encourage the rapid turnover of assets (e.g., remuneration policies, internal replacements policies).

Investment policies

Policies producing less easily predictable investment return.

B) ENVIRONMENT (economic, governments' measures such as monetary and fiscal policies...)

- o products developed to take advantage of a favorable environment: e.g., products based on high interest rates; products priced while assuming high increases of assets;
- o important interest rate variations;
- o these variations are currently difficult to predict: economic instability.

* : significant consideration.

3.5 DESCRIPTION OF THE LOW MARGIN SITUATION

Important note

The Valuation Actuary can use the 80-20 weighting (80% for the expected assumption and 20% for the maximum margin assumption) when several of the following conditions (or similar ones) are known at the time of the calculation of reserves.

I. Misestimation

- o the valuation applies to an existing product with a good experience for cash flows projections;
- o the investment income allocation is relatively sophisticated;
- o the interest rate assumption is directly determined from an explicit allocation of assets and investment return;
- o the valuation interest rate is mainly affected by the yield on current portfolio.

II. Deterioration

A) COMPANY

i) Structural

Products

- o little chance of antiselection due to strict contractual clauses;
- o cash values are small or non-guaranteed with market value adjustment.

Assets

- o assets backing liabilities do not allow much possibility of exercising options;
- o matching is verified and found adequate;
- o the quality of assets is higher than average.

Management

- o the company adjusts rapidly to changes;

- o the investment policy is clearly defined and understood by the actuary.

ii) Discretionary

Circumstances do not encourage the rapid turnover of assets (e.g., remuneration policies, internal replacement policies).

Investment policies

Policies favoring predictable investment return.

B) ENVIRONMENT (economic, governmental measures, such as monetary and fiscal policies...)

- o the economic situation is stable;
- o the long term forecast of economic stability.

SUBCOMMITTEE ON PROVISIONS FOR ADVERSE DEVIATIONS

VALUATION ASSUMPTION FOR APPROPRIATE INCOME STATEMENT

SECTION 4

Line of business : Individual life

Assumption : Issue and administrative expenses and inflation rate

4.0 INTRODUCTION

A strict definition regarding issue expenses is not required when the valuation method does not specify a maximum issue expense which may be deferred. However a more specific definition of administrative expenses is needed since they have a significant impact on the reserve level.

The Valuation Actuary must make sure that all the issue and administrative expenses assumed in the calculation of reserves represent the amount of expenses taken from the annual statement for each line of business. These expenses include general expenses, remuneration to agents and brokers, premium taxes, licenses and fees and investment expenses not deducted from investment income.

The Valuation Actuary should not overestimate the amount of issue expenses because it implies that administrative expenses and reserves will decrease.

The above paragraphs define the expense assumption used in the year of valuation. The Valuation Actuary must also define an inflation rate to project the increase in administratives expenses into the future. This inflation rate should be related to the interest rate assumption and should not in any case take into account any future in-force increase rate. The margin on the inflation rate is used to reflect any possible deterioration in the future administrative expenses.

4.1 DEFINITION

The valuation assumption is a weighted average of an expected assumption (Section 4.2) and a maximum margin assumption (Section 4.3).

The weighting for both assumptions should lie between the following:

	WEIGHTING	
	Expected assumption	Maximum margin assumption
Situation of high margin	20%	80%
Situation of low margin	80%	20%

The weighting will be determined by the Valuation Actuary considering the situation of his own company.

When 1 out of the 3 significant considerations leading to a high margin situation are present, the weighting must include at least 50% of the maximum margin assumption.

4.2 EXPECTED ASSUMPTION

The expected assumption for issue and administrative expenses is determined by the Valuation Actuary using internal expense analysis of his own company and nothing else.

The specific definition of administrative expenses appears at the end of the section.

In defining the expected assumption, the actuary should consider the following items:

Pricing Assumptions

- Limitation in the degree of flexibility for adjustments in gross premium due to the nature of the premium guarantees, their duration and the guaranteed maximum increase for the gross premium;

- There should be a certain consistency between pricing and valuation assumptions as to issue and administrative expenses and the inflation rate.

Company characteristics

- In-force amounts and expected growth rate, particularly in the case where the expected growth rate is used to reduce the assumed inflation rate in the reserve calculation;

- Company policy about the control of general expenses;

- Writing off of some general expenses and their duration; those written off expenses are not subject to inflation;

- Celerity in revising the non-guaranteed premiums and other policy values to reflect the difference between expected and realized experiences;

- Distribution of the in-force amounts by lines of business and their respective growth rates;

    o any development plan regarding a line of business will affect the distribution of the general expenses (particularly the expenses indirectly imputed to a line of business).

- Distribution of the in-force amounts within a line of business by products and their respective rates of growth

    o we could have different unit expenses by products or by type of guarantees (contracts, riders, clauses).

Commissions scale and renewal bonuses

- Probability of agent's turnover, particularly if the commissions and/or bonus are not vested;

- Company policy concerning orphan policies;

- Company policy concerning replacement of policies;

- Differences in compensations;

    o It is known that the termination rates among full time agents are lower than among brokers. This could have an impact on the average level of renewal commissions assumed.

DEFINITION OF ADMINISTRATIVE EXPENSES:

The administrative expenses should include all general expenses directly incurred for the following expense analysis functions:

- Gross premiums collection

- Renewal commission and bonus payments to brokers and agents

- Minor policy changes such as change of address, beneficiary, premium payment mode, etc...

- Major policy changes such as change of plan, insurance coverage increase, etc...

- Reinstatements

- Lapses with or without cash value, death, term or endowment maturity

- Disability claims (premium waiver and monthly income)

- Financial statements and calculation of reserves

- Depreciation costs of purchases of computer equipment, development of new business lines, opening of new agencies, etc...

- Equitable share of Agencies and Marketing Department costs as between issue and administrative expenses

- Maintenance of policyholder records

- etc...

For each of these expense analysis functions, we must add to the directly incurred expenses an equitable share of indirect expenses such as:

- Management/Supervision

- Mail and postal deliveries

- Telephone

- Photocopies

- Rent

- Supplies and storage

- etc...

4.3 MAXIMUM MARGIN ASSUMPTION

Administrative expenses

The Valuation Actuary must make sure that a minimum percentage of general expenses is assumed as administrative expenses in the reserve valuation.

The suggested formula is:

$$\text{Minimum percentage} = \frac{RP'}{RP' + Z \times FP} \times 100$$

Where:

$$RP' = RP \times 1 + \frac{A}{2}$$

FP = First year gross premiums

RP = Renewal gross premiums

A = $\frac{\text{Number of paid up policies}}{\text{number of renewals}}$

Z = $\frac{\text{Average issue expenses}}{\text{Average administrative expenses}}$

- o The Z factor will be such that a very high % (presently, a factor of 4 is considered) of the companies will pass the test. The subcommittee will determine the Z factor after consultation with the profession.

The administrative expenses calculated in this way must not be less than those assumed in the expected assumption.

The unit expenses used in the calculation of reserves shall not decrease when projected.

Ultimate inflation rate

The ultimate inflation rate assumed must be at least the difference between the ultimate reinvestment interest rate and 3%.

4.4 DESCRIPTION OF THE HIGH MARGIN SITUATION

Important note

The Valuation Actuary must use the 20-80 weighting (20% for the expected assumption and 80% for the maximum margin assumption) when some of the following conditions are known at the time of the calculation of reserves.

I. Misestimation

- o the distribution of general expenses by line of business, by product and by issue and administrative expenses is based on an obsolete internal expense study;

* o the distribution of expenses for the calculation of reserves does not reflect the amount of general expenses found in the annual statement;

- o the distribution of in-force amounts by line of business and by product fluctuates over time;

* - o there are different compensation contracts for full-time agents, brokers and general agents; the distribution of in-force amounts and volume of new business is unstable among these three groups from year-to-year.

II. Deterioration

- o the volume of new business and in-force amounts as well as their respective growth rate are very unstable over time;

- o the level of administrative expenses assumed in the reserve calculation is based on hypothetical or not well established cost control measures;

- o the renewal bonus paid is calculated as a function of lapse rates and those lapse rates fluctuate over time;

- o the renewal commissions and bonus are not paid to the agent after his termination and the valuation assumption states that the agent's contract will remain in force after his departure;

- o there exists different compensation contracts for agents and brokers and the lapse rates for policies sold by one or the other are different;

* - o an assumed increasing rate of in-force is used to reduce the assumed inflation rate or even produce decreasing unit expenses.

4.5 DESCRIPTION OF THE LOW MARGIN SITUATION

Important Note

The Valuation Actuary can use the 80-20 weighting (80% for the expected actuary assumption and 20% for the maximum margin assumption) when several of the following conditions are known at the time of the calculation of reserves.

I. Misestimation

- o The distribution of general expenses by lines of business, by product and by issue and administrative expenses is based on a recent internal expense study;

*:significant consideration

- o the distribution of expenses for the calculation of reserves reflects the amount of general expenses found in the annual statement;

- o the distribution of in-force amounts is very stable by line of business and by product over time;

- o the same compensation contract applies to all full-time agents, brokers and general agents.

II. Deterioration

- o the volume of new business and in-force amounts as well as their respective growth rates are stable over time;

- o the level of administrative expenses assumed in the calculation of reserves is supported by efficient and well established cost control measures;

- o the renewal bonus is quite stable and not particularly affected by lapse rates;

- o the renewal commissions and bonus are paid to the agent after his departure or they are transferred to other agents.

- o the ultimate inflation rate assumed is at least the difference between the ultimate reinvestment interest rate used in the calculation of reserves and 3%;

- o the inflation rate assumption is completely independent from the growth rate of in-force.

VALUATION ASSUMPTION FOR APPROPRIATE INCOME STATEMENT

SECTION 5

Line of business: Individual Life

Assumption : Lapse rates

5.0 INTRODUCTION

The margin added to the expected lapse rate must be positive when the non-forfeiture value is greater than the reserve and negative when the opposite is true.

This can be seen by looking at the release in policy year t from the provision for adverse deviations:

$$R_t = (1-q^d_t) \cdot {}_{\Delta}W_t \cdot (NF_t - V_t) \text{ for } t \quad 1$$

where:

q^d_t	Mortality rate for policy year t
${}_{\Delta}W_t$	Margin added to the expected lapse rate for policy year t
NF_t	Non-forfeiture value at the end of policy year t
V_t	Reserve at the end of policy year t

The valuation assumption is obtained by applying a % to the expected lapse rate. The % varies above or below 100% according to the sign of (NF_t-V_t) and in magnitude in relation with the situation of the company and product.

A rigorous use of this principle would imply a specific calculation of margins for each policy. However, grouping the policies for such a test would also be acceptable as long as such grouping only includes policies of a same type of plan.

5.1 DEFINITION

The valuation assumption is X times the expected assumption where X =

100%	For duration A and for the period starting at point B, where:

Point A

The valuation date (or the first duration where the reserve is higher than the non-forfeiture value if this eventuality happens after the valuation date).

Point B

Beginning of the period, ending at maturity of the contract, for which the cancellation of the contract would have no clear advantage or disadvantage to the insured.

The % in the table below	From (duration A + 10 years) to point B; and for a valuation date before point A.
Interpolation between known points	For durations not defined above.

TABLE

The % will be determined by the Valuation Actuary considering the company's situation and the product. It should lie between the following:

	Sign of the non-forfeiture value less the reserve	
	+	-
Situation of high margin	140%	60%
Situation of low margin	110%	90%

While 1 out of the 3 significant considerations leading to a high margin situation are present, the % chosen must be closer to that situation.

5.2 EXPECTED ASSUMPTION

The expected assumption should be the Valuation Actuary's best estimate as to the future experience for the product.

When available, he should consider successively the following sources:

1. His own company's experience and studies.

2. If 1. is not available:

   a) intercompany studies; or,

   b) pricing assumption if a) is not available.

   The actuary should consider these sources only as a last resort. In such a situation, it is expected that he will be in a maximum margin situation.

In defining the expected assumption, the actuary should consider the following list of items:

- Issue age and duration (or attained age)
- Type of product (permanent, temporary, etc.)
- Sex
- Type of underwriting (medical, paramedical, non-medical)
- Risk class (preferred, standard, etc.)
- Amount of insurance
- Mode of payment and frequency
- Status (premium paying, paid-up, reduced paid-up)
- Level of non-forfeiture values and other pertinent features
- Pertinent legislation (insurance laws, tax laws, etc.)
- Policy of internal replacement
- Economic situation (level of interest rate, etc.)
- Competitive situation for the product
- Quality of remuneration and turnover rate of sales personnel
- Quality and type of service to clients (involvement of sales personnel)

5.3 DESCRIPTION OF HIGH MARGIN SITUATION

Important Note

The actuary must consider that the situation is one of high margin when some of the following considerations (or similar ones) are known at the valuation date.

I. Misestimation

- o it is a new product or new type of coverage;
- * o the company has little information on the experience;
- o there is little homogeneity in the characteristics of the insureds.

II. Deterioration

Note

The conditions given below apply to durations for which a decrease in lapse rates increases liabilities. Otherwise, the reverse conditions justify the high margin.

A) COMPANY

i) Structural

Products

- o the company sets itself apart through product design rather than competitive premiums;
- o the product is an innovative one meeting a new need;
- o the company seldom changes product line.

Agents

- o the company does not depend entirely on the agent in its contact with the insured.

Management

- o the company quickly adjusts to any changes affecting it. Examples:

- o improvement of existing contracts
- o modified remuneration

ii) Discretionary (past, present or future)

Products

- o the company improves existing products rather than implementing an internal replacement policy.

Agents

* - o the remuneration policy favors persistency.

B) THE INSURED

* The cancellation of a contract by the insured would be clearly disadvantageous to him or her.

C) ENVIRONMENT (economy, government measures such as monetary and fiscal policies...)

The product does not depend on an environment likely to be favorable in the short term only.

* : significant consideration.

5.4 DESCRIPTION OF THE LOW MARGIN SITUATION

Important note

The actuary must consider that the situation is one of low margin when many of the following considerations (or similar ones) are known at the valuation date.

I. Misestimation

- o the product or type of coverage is one for which the company has a lot of information on the experience and this data is relevant in the current and expected future market and economic environment;
- o there is strong homogeneity in the characteristics of the insured population (and the actuary foresees no major changes in these characteristics).

II. Deterioration

Note

The conditions given below apply to durations for which a decrease in lapse rates increases liabilities. Otherwise, the reverse conditions justify the low margin.

A) COMPANY

i) Structural

Products

- o the company competes on the basis of premium and does not set itself apart through product design;
- o innovative product now subject to competition;
- o the company frequently changes its product line.

Agents

- o the company depends entirely on the agent in its contacts with the insured and turnover among agents is high.

Management

- o the company is slow to adjust to changes affecting the persistency of its products.

ii) Discretionary (past, present or future)

Products

- o rather than improving the product in question, the company implements an internal replacement policy.

Agents

- o the remuneration policy encourages terminations.

B) THE INSURED

The insured stands to gain significantly from cancelling his contract.

C) ENVIRONMENT (economy, government measures such as monetary and fiscal policies...)

The product depends on an environment which could be favorable in the short term only.

6.3 ANALYSIS OF THE NUMERICAL EXAMPLES

Comparing the results under the two methods was useful in showing us that the apparent sensitivity to changes in assumptions was not inherent to our system. From the first page in section 6.1 (non par whole life - age 35), we see that the first year book profit, when using the CIA method, goes from -4.54 to -4.27 when we add a low margin to the assumptions (this illogicality in the first year is inherent to the 150% limit on acquisition expenses). Under the policy premium method, the first year book profit goes from 1.94 to -0.06 when adding the same low margin. So we see that the variation in first year results depends on the method used.* (It should be noted that results are independent of the valuation method when adding a high margin, the product being on a deficiency basis under the CIA method).

Beside considering the provision implied by a certain level of margin, we also wanted to look at its release in profits as years go by. This was an attempt to better understand the "fair risk charge" and "release from risk" principles. Again from the first page, we see that under the policy premium method (high margin situation), 37% of the first year provision has flown back into earnings after 10 years; and 79% after 20 years. As much as this is interesting, it does not tell us what kind of "release pattern" an appropriate provision should have. It does, however, provide a good tool for searching for it.

Section 6.2 provided us with a tool for evaluating the appropriateness of our parameters. By using an assumption with margin while holding the other assumptions constant, we could evaluate its impact on the provision. We could then reflect the results by plan and age to determine if the relative impacts of the assumptions were logical. As an example, for the low cash value endowment to 100 one would expect the lapse rate to be the critical assumption. Unexpected relationships were researched more thoroughly to see if changes were needed in the parameters.

Those calculations also helped us in studying the cumulative impact of the margins. For the non par whole life example at age 35, the total of the first year provisions for the assumptions with high margin was 8.34. However, when we run a test using all the assumptions with high margin at the same time, we get a first year provision of 10.80. We are still looking, both theoretically

* Even by removing the 150% limit on the CIA method and amortizing the acquisition expenses from issue instead of renewal only, as long as we are not in a deficiency premium situation, the policy premium method will be more sensitive in the first year than that modified CIA method by a factor of x.

and practically, to find a case where the assumptions did not interact in an additive way.

Finally, the other interesting aspects of section 6.2 are the comparisons of the first year provision with the expected first year profit for the policy and its gross premium. If the ratio of the provision to the profit is less than one, then it means that the policy would show a book profit in the first year.

One should always remember that apart from the choice of the different parameters, those resulting ratios are materially affected by the differences between the expected assumptions for valuation purposes and pricing assumptions.

APPENDIX A-1

DESCRIPTION OF THE 3 EXAMPLES WITH VALUATION ASSUMPTIONS

I. PLAN

Example #1 : Non-Par Whole Life

#2 : Low cash values endowment to 100

#3 : 20 year term

Cash values

i) Example #1 (Non-Par Whole Life)

Cash values are a % of tax reserves.

The % is 10% at duration 4, increasing by 5% per year (maximum of 90%).

ii) Example #2 (Low cash values endowment to 100)

Same as i) except that no cash values are available before attained age 65.

iii) Example #3 (20 year term)

Nil.

II. EXPECTED ASSUMPTIONS

Note

The assumptions are used for the 3 examples unless specifically mentioned.

VOLUME	$100,000 of insurance
INSURED	Male non-smoker Age 35 and 55
MORTALITY	80% CIA69-75 Male Select
SMOKING	Bill C-139 version
INTEREST	10% decreasing .2% per year (minimum of 6%)
LAPSE RATES	15% - 10% - 7 1/2% and 5% for after

Exception: For the example #2, lapse rates differ for some attained ages:

Attained age	Rate	Attained age	Rate
59	5%	65	10%
60	4%	66	9%
61	3%	67	8%
62	2%	68	7%
63	1%	69	6%
64	0%	70+	5%

EXPENSES Acquisitions $250 per policy + 20% of the premium

Maintenance $30 per policy indexed at 3% per year

Commissions

Year	Base (%)	Bonus (%)
1	65	55
2	15	2
3	12	2
4	5	2
5-10	3	2
11 +	-	-

Taxes 2%

III. GROSS PREMIUM PER THOUSAND

The gross premium are calculated on the basis of the expected assumptions then increase by 4% of gross premium for an explicit profit margin.

Issue age	EXAMPLE 1	2	3
35	6.53	4.60	2.50
55	19.32		11.10

IV. VALUATION ASSUMPTIONS

Note

Under the policy premium method, the first year profit for the test without margin in the present value of the explicit annual profit which is 4% of gross premium.

ASSUMPTIONS	DURATION	LEVEL OF THE MARGIN		
		No	Low	High
LAPSES (%)	1	15.00	15.00	15.00
	2	10.00	9.90	9.60
	3	7.50	7.35	6.90
	4	5.00	4.85	4.40
	5	5.00	4.80	4.20
	6	5.00	4.75	4.00
	7	5.00	4.70	3.80
	8	5.00	4.65	3.60
	9	5.00	4.60	3.40
	10	5.00	4.55	3.20
	11 +	5.00	4.50	3.00
		Note: For the example #2, the assumption cannot be higher than the pricing assumption during the "clift" period.		
MORTALITY		80% CIA	80% CIA + .00375 ex	80% CIA + .015 ex
EXPENSES		250.00	240.00	210.00
		30.00	30.70	32.80
INTEREST (%)	1	10.00	10.00	10.00
	2	9.80	9.74	9.56
	3	9.60	9.48	9.12
	4	9.40	9.22	8.68
	5	9.20	8.98	8.33
	6	9.00	8.75	8.02
	7	8.80	8.53	7.72
	8	8.60	8.31	7.42
	9	8.40	8.10	7.19
	10	8.20	7.86	6.85
	11	8.00	7.59	6.37
	12	7.80	7.37	6.08
	13	7.60	7.16	5.86
	14	7.40	6.98	5.70
	15	7.20	6.78	5.54
	16	7.00	6.60	5.40
	17	6.80	6.44	5.36
	18	6.60	6.28	5.32
	19	6.40	6.12	5.28
	20	6.20	5.96	5.24
	21+	6.00	5.80	5.20

Note

The maximum margin assumption for the interest rate was obtained by the method described in the following pages.

However, the following example is shown for illustrative purposes only and its resulting interest vector is not the one that was used in the weighting process.

COLUMN	DEFINITION
(1)	Average ${}_{tp}T_x$

For this column and for the determination of the cash flows, we have assumed the following proportions between the different products and the two ages (35 and 55):

T-20	:	50%			
T-100	:	25%	35 years	:	60%
Whole life	:	25%	55 years	:	40%

(2) Reinvestment rate.

(3) Term of reinvestments when the amount to invest (14) is positive.

(4) Premiums

For the first year:

50% (60% x 2.50 + 40% x 11.10)

+ 25% (60% x 4.60 + 40% x 19.13)

+ 25% (60% x 6.53 + 40% x 19.32)

= 8.48

For the following years, we have to multiply each premium by the corresponding ${}_{tp}T_x$.

(5) Expenses

(6) Face amount payments.

COLUMN	DEFINITION
(7)	Cash value payments.
(8)	(4) - (5) - (6) - (7)
(9)	Interest earned on investments

Example of interest earned in policy year 6 for TEST IV:

Policy Year (PY)	Initial Capital to Invest	Repayment from options PY=5	Repayment from options PY=6	(1)-(2)	Reinvestment Rate	(3)x(4)
	(1)	(2)		(3)	(4)	
4	1.97	.02	.039	1.911	.093	.177
5	3.61	-	.036	3.574	.09	.322
		.02	.07			.50
$(COLUMN)_{PY}$ (14)		$(13)_5$	$(13)_6$		(2)	$(9)_6$

(10) Interest on liquidity.

$[(16)_{t-1} + (4) - (5) - 0.5 \times (6)] \times (2)$

(11) Repayment of capital.

(12) Liquidity to reinvest for 1 year when the amount to invest (14) is negative.

(13) Repayment of capital from options that have been exercised.

For every variation of 1% of the reinvestment rate, 4% of the assets are repaid (maximum of 20% for a variation of 5%).

COLUMN	DEFINITION
(14)	= (8) + (9) + (10) + (11) + (12) + (13)
(15)	Amount of investments that have not matured and that have not been repaid.
(16)	Amount of liquidity.
(17)	(15) + (16)
(18)	$[(9) + (10)]/[(17)_{t-1} + (4) - (5) - 0.5 \times (6)]$

APPENDIX B-1

DESCRIPTION OF THE FORMULAS

I. BOOK PROFITS FROM OPERATIONS

$$BP_t(\text{end of year}) = (GP - E_t \times (1 + i_t) - 1000\, q_{x+t-1} \times \left(\frac{1 + i_t}{2}\right) - CV_t(1 - q_{x+t-1}) \times w_t - [{}_tV\,(1 - q_{x+t-1})\,(1 - w_t) - {}_{t-1}V(1+i_t)]$$

where
- GP : Gross premium
- E_t : All expenses (fixed and/or in %)
- i_x : Interest rate
- q : Mortality rate
- CV_t : Cash value at t
- w_t : Lapse rate at t
- ${}_tV$: Reserve at t

II. PRESENT VALUE OF BOOK PROFIT OCCURRING IN YEAR t AT TIME = 1

$$PVBP_t \text{ at time } = 1 \quad = \quad BP_t \times F_t$$

where $F_1 = 1$

$$t \quad 2 \quad F_t = F_{t-1} \times \frac{(1 - q_{x+t-2})\,(1-w_{t-1})}{(1 + j_t)}$$

j_t : Interest rate (we used $i_t = j_t$)

III. CIA RESERVE (SYMBOLS ARE SIMILAR TO TECHNICAL PAPER #1)

$$
\begin{aligned}
{}_tV &= 1000\, A_{x+t} \\
&+ \sum_{s=t}^{W} v^{s+1-t}\ {}_{s-t}P^{T}_{x+t}(1 - q_{xts})w_s CV_s \\
&+ \sum_{s=t}^{W} v^{s-t}\ {}_{s-t}P^{T}_{x+t} E^{ADM} \quad \text{(adm. charges component)} \\
&- p^{CIA}\, \ddot{a}_{x+t}
\end{aligned}
$$

where p^{CIA} = min (Gross premium, M)

$$
\begin{aligned}
M &= N + [\min (1.5N, \tfrac{250}{100} + K1 \times G)] \div 1/\ddot{a}_x \\
&\quad + \sum_{t=0}^{W} v^t\ {}_tP^{T}_x \times (\tfrac{30}{100}\, 1.03^t + K2 \times G)] \div \ddot{a}_x \quad \text{(adm. charges component)}
\end{aligned}
$$

$$
N = \frac{1000\, A_x + \sum_{t=1}^{W} v^t\ {}_{t-1}P^{T}_x \times (1-q_{x+t-1})\ w_t\ CV_t}{\ddot{a}_x}
$$

$$
K1 = 65\% + 55\% + 20\% = 140\%
$$

$$
\begin{aligned}
K2 = {} & 2\% + 0\% + 0\% = 2\%, \quad t=0 \\
& 2\% + 15\% + 2\% = 19\%, \quad t=1 \\
& 2\% + 12\% + 2\% = 16\%, \quad t=2 \\
& \ldots \\
& 2\% + 3\% + 2\% = 7\%, \quad t=9 \\
& 2\%, \quad t=10 \text{ and so on...}
\end{aligned}
$$

P^{T}_x = surviving probability (all decrements)$=(1-q_x)\ (1-w)$

Note

The additional part in the reserve for the administrative charges can't decrease the reserve.

IV. POLICY PREMIUM RESERVE

$$
\begin{aligned}
{}_tV \;=\; & 1000\, A_{x+t} \\
& + \sum_{s=t}^{w} v^{s+1-t}\; {}_{s-t}p^{T}_{x+t}\; (1 - q_{x+s})\; w_s CV_s \\
& + \sum_{s=t}^{w} v^{s-t}\; {}_{s-t}p^{T}_{x+t}\; E^{ADM} \\
& - GP\; \ddot{a}_{x+t}
\end{aligned}
$$